ABSTRACT

Study of the Various Effects Contributing to the Energy and Mass Resolution of a Dual-Readout Calorimeter
Nayeli Azucena Rodriguez Briones (Universidad Autónoma de Zacatecas, México), Adam Para and Hans Wenzel (Fermi National Accelerator Laboratory, Batavia, IL 60510).

The response of a calorimeter is very different for e+, e- and photons compared to hadrons. For e+, e- and photons, the total energy of the incoming particle is converted into detectable kinetic energy of electrons leading to excellent energy resolution for electrons/photons. Hadrons on the other hand break nuclei and liberate nucleons/nuclear fragments. Even if the kinetic energy of the resulting nucleons is measured, the significant fraction of energy is lost to overcome the binding energy. Fluctuations of the number of broken nuclei dominate fluctuations of the observed energy leading to a relatively poor energy resolution for hadrons. Novel calorimeter concepts under consideration for future lepton collider experiments are aimed to achieve high-energy resolution for single hadrons and for hadronic jets. The energy resolution improvement is achieved by reading out two different signal components: scintillation light which is proportional to the energy deposited via ionization and Cerenkov light which is used as an estimator of the energy loss due to nuclear processes. The Cerenkov signal can be used to correct the energy deposit as measured by the scintillation signal. Reconstruction of jet-jet invariant mass in a segmented total absorption dual-readout calorimeter is investigated in a specific example of the crystal-based calorimeter for the SiD detector. The detector geometry is defined and the detector simulation is carried out within the Geant4-based Simulation for Linear Collider (SLIC) framework. The analysis programs are developed in JAVA within the Java Analysis Studio (JAS)[3] environment. Contributions to the energy and mass resolution related to the calorimeter granularity, shower spatial extent and bending of particles in the magnetic field are identified and determined as a function of the particle type and momentum and of the strength of the magnetic field.